many years back; whence it may be inferred that the planes of their orbits are really or nearly at right angles with the visual ray.

Dr. Herschel being aware that the observations he brings forward in this paper are of a nature so delicate and minute as to afford opportunities for cavil, has been at considerable pains to point out the principal circumstances that contribute to the perfection of telescopes and micrometers, and the precautions to be used as to the state of the atmosphere. Those ought, he thinks, to be particularly attended to by accurate observers.

An Account of the Measurement of an Arc of the Meridian, extending from Dunnose, in the Isle of Wight, Latitude 50° 37′ 8″, *to Clifton, in Yorkshire, Latitude* 53° 27′ 31″, *in course of the Operations carried on for the Trigonometrical Survey of England, in the Years* 1800, 1801, *and* 1802. *By Major* William Mudge, *of the Royal Artillery, F.R.S.* Read June 23, 1803. [*Phil. Trans.* 1803, *p.* 383.]

In this paper we are presented with a further continuation of the several accounts given, ever since the year 1785, of the trigonometrical surveys carried on over various parts of the kingdom. Having now proceeded a great way in these surveys, Major Mudge thought it high time to attempt the measurement of a considerable arc of the meridian in our latitudes. He first assigns his reasons for preferring the meridian he has here adopted, which depend chiefly on the nature of the country being less hilly and liable to less obstruction than any other tract of the length of this arc in the island. He fixed on Dunnose, in latitude 50° 37′ 8″, for the southern extremity, and on Clifton, a small village in the vicinity of Doncaster, latitude 53° 27′ 31″, for the northern termination of this arc: and near the latter place he found a convenient plain, viz. Misterton Carr, for the measurement of a base of verification.

As the accuracy of the zenith observations would be most essential towards the perfection of this measurement, a new zenith sector was constructed for the purpose by Mr. Ramsden, and finished by Mr. Berge, the excellence of which is here attested by its being called the first instrument of its kind. Its merits consist chiefly in the means of uniting the sectorial tube to its axis, so as to insure the permanency of the length of its radius when erected for observation; in a more accurate method of adjusting the instrument vertically; an easy way of placing the face of its arch in the plane of the meridian; and a contrivance by which the plumb-line can be brought precisely over the point marking the centre of the circle, of which the divided arch of the sector should be a part.

Having given a minute description of this instrument, and of the preparatory operations for the series of observations to be made with it, such as the construction of a proper observatory, and other auxiliary requisites, the author proceeds to give us, in different tables,

the angles of a number of triangles observed near the north end of the arc; the calculations of the sides of a series of triangles extending from Dunnose to Clifton; and, from these data, a calculation of the meridional distance between Dunnose and Clifton. Then come the observations with the zenith sector at Dunnose, Clifton, and Arbury Hill, near Daventry, a point almost in the middle of the arc, which was chosen with a view to ascertain how far the observations at the terminations would agree with others made for finding the value of its parts. A few additional observations made at the Royal Observatory are also given, serving to demonstrate the precision of the former ones, and the accuracy of the instrument.

Next follow the extensive and laborious calculations by which, in order to assimilate the numerous observations made at different times, they are all reduced, from the respective days on which they were made to the 1st of January 1802: the equations here introduced are those for aberration, nutation, semi-annual solar equation, precession, and refraction.

The general conclusions deduced from this ample stock of observations and calculations are, that the whole arc, subtending an angle of 2° 50′ 23″, measures 1,036,337 feet; so that the length of a degree on the meridian, in latitude 52° 2′ 20″, is = 60·820 fathoms. This degree, at the latitude of Arbury Hill, is found to be 42 fathoms longer; whereas, admitting the earth to be an ellipsoid, with the ratio of its axis as 229 to 230, it should be 10 fathoms less. On maturely weighing all the causes that may have occasioned this deviation, it is thought most likely that, owing to different attractive forces, which increase as we proceed northward, the plumb-line of the sector has been drawn somewhat towards the south at each of the stations,—a circumstance that must be carefully attended to in the prosecution of this survey, whenever the zenith sector is to be used. It is observed in general, that meridional observations carried on in insular countries are not so likely to afford just conclusions, with regard to the different lengths of the degrees, as the same operations if conducted in places very remote from deep seas.

Adverting, lastly, to the operations of the French astronomers who have measured the arc of the meridian between Paris and Barcelona, which distance was found = 3,527,921 English feet, this, combined with the arc lately measured, gives the whole meridional distance between Clifton and Barcelona, being 12° 5′ 42″·79, something more than the thirtieth part of the whole circumference of the globe, = 4,411,968 feet. According to this determination, the mean length of a degree of the meridian, in latitude 47° 24′, will be = 60,795 fathoms; and in the latitude 51° 9′, the degree will measure 60,825 fathoms.

In an Appendix are subjoined the latitudes and longitudes of those places intersected in the surveys of Essex, Suffolk, &c. whose distances from their respective places of observation are given in the Philosophical Transactions for 1800; which, it is asserted, cannot

but be highly useful, as they may be depended on; the interior surveys of those parts having since proved that no erroneous intersections had been made in those operations.

The Bakerian *Lecture. Experiments and Calculations relative to physical Optics. By* Thomas Young, *M.D. F.R.S.* Read November 24, 1803. [*Phil. Trans.* 1804, *p.* 1.]

It consists of six sections, the first of which is intended to convey an experimental demonstration of the general law of the interference of light. This demonstration rests on two experiments, the results of which are brought in proof, that fringes of colours, and even the crested fringes described by Grimaldi, are produced by the interference of two portions of light. These results are, that if one of the two edges of a shadow produced by a narrow opake body be intercepted by a screen at a small distance from that body, the opposite edge will no longer exhibit the fringed appearance which it had in common with the former edge, when the latter was not intercepted.

Under the second head we have a comparison of measures of the intervals of disappearance of light when refracted between two edges of knives, or intercepted by a hair or a thin wire. The experiments, which were partly suggested by some observations of Sir Isaac Newton, are here collected in tables: and the author states, as a general inference, that if we thus examine the dimensions of the fringes under different circumstances, we may calculate the differences of the lengths of the paths of the portions of light which have been proved to be concerned in producing those fringes; and we shall find, that where the lengths are equal, the light always remains white; but that where either the brightest light, or the light of any given colour, disappears and reappears a first, a second, or a third time, the differences of the paths of the two portions are nearly in an arithmetical progression.

In the third section, these principles are applied to explain the repetition of colours sometimes observed within the common rainbow, particularly those described in the Philosophical Transactions by Dr. Langwith and Mr. Daval. The train of reasoning here adduced would lose too much of its evidence by being abridged.

The fourth section is entitled, "Argumentative inference respecting the Nature of Light." Here we meet with something of a controversial nature, in which those who have adopted theories different from that which our author is desirous to establish, are called upon to explain his experiments according to their principles. What appears to him to operate chiefly against the advocates for the projectile hypothesis of light, is, that light moves more slowly in a denser than in a rarer medium, and that hence refraction is not the effect of an attractive force directed to a denser medium.

The fifth section treats of the colours of natural bodies. The nature of the light transmitted by various bodies is here described, but